Electronic Version
Stylesheet Version v1.1.1

Claims

[c1] A process for improving the oxidation resistance of an overlay coating, the process comprising the steps of:
depositing the overlay coating on a surface of a substrate, the overlay coating being deposited so as to be characterized by as-deposited grains that define as-deposited grain boundaries that intersect the outer surface of the overlay coating, at least some of the as-deposited grain boundaries being open at the outer surface of the overlay coating;
peening the overlay coating with a particulate media formed of a composition containing nickel and aluminum; and then
heating the overlay coating to a temperature sufficient to cause the overlay coating to recrystallize and form new grain boundaries that are not open to the outer surface of the overlay coating.

[c2] The process according to claim 1, wherein the heating step comprises heating the overlay coating to a temperature of at least 900°C.

[c3] The process according to claim 1, wherein the overlay coating is primarily beta-phase nickel aluminide inter-

metallic.

[c4] The process according to claim 1, wherein the as-deposited grain boundaries contain more precipitates than the new grain boundaries.

[c5] The process according to claim 1, wherein the overlay coating contains at least one of zirconium and hafnium.

[c6] The process according to claim 5, wherein the composition of the particulate media is an intermetallic and contains at least one of zirconium and hafnium.

[c7] The process according to claim 1, wherein the composition of the particulate media is substantially free of iron.

[c8] The process according to claim 1, wherein the composition of the particulate media comprises a metallic solid solution and contains yttrium.

[c9] The process according to claim 8, further comprising the steps of producing the particulate media to have relative finer and coarser particles, using the coarser particles in the peening step, and plasma spraying the finer particles on a second substrate to form a NiCrAlY coating on the second substrate.

[c10] The process according to claim 1, further comprising the step of depositing a ceramic coating on the overlay coat-

ing to form a thermal barrier coating system.

[c11] The process according to claim 10, further comprising the step of subjecting the thermal barrier coating system to an elevated temperature to form an oxide scale between the overlay coating and the ceramic coating, the oxide scale being substantially free of spinel.

[c12] A process for improving the oxidation resistance of a beta-phase nickel aluminide overlay coating and improving the spallation resistance of a ceramic coating deposited on the overlay coating, the process comprising the steps of:

depositing the overlay coating on a surface of a superalloy component by a physical vapor deposition technique, the overlay coating having as-deposited grains defining as-deposited grain boundaries that are continuous through the overlay coating from an outer surface of the overlay coating to the surface of the component, at least some of the as-deposited grain boundaries containing precipitates and being open at the outer surface of the overlay coating;

peening the overlay coating with a particulate media formed of a composition that contains nickel, aluminum and chromium and is essentially free of iron;

heat treating the overlay coating to a temperature sufficient to cause the overlay coating to recrystallize and

form new grain boundaries that are not open to the outer surface of the overlay coating and contain fewer precipitates than the as-deposited grain boundaries;
depositing a ceramic coating on the overlay coating to form a thermal barrier coating system; and
subjecting the thermal barrier coating system to an elevated temperature to form an oxide scale between the overlay coating and the ceramic coating, the oxide scale being substantially free of spinel.

[c13] The process according to claim 12, wherein the heating step comprises heating the overlay coating to a temperature of at least 900°C in a low-oxygen atmosphere.

[c14] The process according to claim 12, wherein the overlay coating contains at least one of zirconium and hafnium.

[c15] The process according to claim 14, wherein the overlay coating further contains chromium.

[c16] The process according to claim 14, wherein the precipitates present in the as-deposited grain boundaries contain at least one of zirconium and hafnium, and the precipitates are substantially absent from the new grain boundaries.

[c17] The process according to claim 14, wherein the composition of the particulate media is an intermetallic consist-

ing essentially of nickel, chromium, aluminum, zirconium, and intermetallics thereof.

[c18] The process according to claim 12, wherein the composition of the particulate media consists essentially of nickel, chromium, aluminum, yttrium and comprises a metallic solid solution and at least one intermetallic phase.

[c19] The process according to claim 12, further comprising the steps of producing the particulate media using a process that yields relative finer and relatively coarser particles, using the coarser particles in the peening step, and plasma spraying the finer particles on a surface of a second component to form a NiCrAlY coating on the second component.

[c20] The process according to claim 19, wherein the coarser particles have a particle size of at least about 400 micrometers.